

U.S. Patent Application Serial No. 10/511,442  
Amendment filed December 28, 2006  
Reply to OA dated September 22, 2006

**AMENDMENTS TO THE CLAIMS:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

**Claim 1 (Currently Amended):** A process for producing a synthetic resin foam comprising the step of reacting at least one polyol with at least one polyisocyanate compound in the presence of an organic blowing agent and a catalyst,

the blowing agent being a mixture comprising 1,1,1,3,3-pentafluorobutane (HFC-365mfc) and at least one halogen-containing compound,

wherein the organic blowing agent and the polyol mixture forms a premix which is substantially nonflammable;

wherein the at least one halogen-containing compound is nonflammable and has a relatively low thermal conductivity and a boiling point of about -90 to about 60°C,

the thermal conductivity of the halogen-containing compounds in the gaseous state is about 8 to about 30 mW/mK at about 1 atmospheric pressure, and

the halogen-containing compound is at least one member selected from the group consisting of 1,2,2-trifluoroethylene trifluoromethyl ether ( $\text{CF}_2=\text{CFOCF}_3$ ), 1,2,2-trifluoroethylene 1,1,2,2,3,3,3-heptafluoropropyl ether ( $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{CF}_3$ ), perfluoropropyl epoxide ( $\text{CF}_3\text{CF}(\text{O})\text{CF}_2$ ), perfluoro-1-butene ( $\text{CF}_2=\text{CFCF}_2\text{CF}_3$ ), perfluorohexenes ( $\text{C}_6\text{F}_{12}$ ), perfluorononenes ( $\text{C}_9\text{F}_{18}$ ), perfluorohexane ( $\text{C}_6\text{F}_{14}$ ), perfluorocyclobutane (*c*- $\text{C}_4\text{F}_8$ ), iodotrifluoromethyl ( $\text{CF}_3\text{I}$ ),

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1,1,1,2,3,3-hexafluoropropane ( $\text{CF}_3\text{CFHCF}_2\text{H}$ ), 1,1,1,3,3,3-hexafluoropropane ( $\text{CF}_3\text{CH}_2\text{CF}_3$ ), 1,1,1,2,3,3,3-heptafluoropropane ( $\text{CF}_3\text{CFHCF}_3$ ), pentafluoroethane ( $\text{CF}_3\text{CF}_2\text{H}$ ), tetrafluoroethanes ( $\text{CHF}_2\text{CHF}_2$ ,  $\text{CF}_3\text{CFH}_2$ ), trifluoromethane ( $\text{CF}_3\text{H}$ ), 1,1,2,2,3,3,4,4-octafluorobutane ( $\text{CF}_2\text{HCF}_2\text{CF}_2\text{CF}_2\text{H}$ ), 1,1,1,2,2,3,4,5,5,5-decafluoropentane ( $\text{CF}_3\text{CF}_2\text{CFHCFHCF}_3$ ), 2-trifluoromethyl-1,1,1,2,3,4,5,5,5-nonafluoropentane ( $\text{C}_6\text{F}_{12}\text{H}_2$ ), 3,3,4,4,5,5,6,6,6-nonafluoro-1-hexene ( $\text{F}(\text{CF}_2)_4\text{CH}=\text{CH}_2$ ), 2,3,3,4,4,5,5-heptafluoro-1-pentene ( $\text{CH}_2\text{CFCF}_2\text{CF}_2\text{CF}_2\text{H}$ ), trifluoroethylene ( $\text{CF}_2\text{CFH}$ ), 1,1,2,2-tetrafluoroethyl difluoromethyl ether ( $\text{CF}_2\text{HCF}_2\text{OCHF}_2$ ), 1,1,2,2-tetrafluoroethyl methyl ether ( $\text{CF}_2\text{HCF}_2\text{OCH}_3$ ), 2,2,2-trifluoroethyl 1,1,2,2-tetrafluoroethyl ether ( $\text{CF}_3\text{CH}_2\text{OCF}_2\text{CF}_2\text{H}$ ), 1,1,2,3,3,3-hexafluoropropyl ~~1,1,2,3,3,3-pentafluoropropyl~~ methyl ether ( $\text{CF}_3\text{CFHCF}_2\text{OCH}_3$ ), nonafluorobutyl methyl ether ( $\text{C}_4\text{F}_9\text{OCH}_3$ ), 1-trifluoromethyl-1,2,2,2-tetrafluoroethyl methyl ether ( $(\text{CF}_3)_2\text{CFOCH}_3$ ), perfluoropropyl methyl ether ( $\text{CF}_3\text{CF}_2\text{CF}_2\text{OCH}_3$ ), 2,2,3,3,3-pentafluoropropyl difluoromethyl ether ( $\text{CF}_3\text{CF}_2\text{CH}_2\text{OCHF}_2$ ), 1,2,3,3,4,4-hexafluorocyclobutane ( $c\text{-C}_4\text{F}_6\text{H}_2$ ), 1-chloro-1,1,2,2,3,3,4,4-octafluorobutane ( $\text{CF}_2\text{ClCF}_2\text{CF}_2\text{CF}_2\text{H}$ , boiling point:  $50^\circ\text{C}$ ), 1,2-dichlorohexafluorocyclobutane ( $\text{-CFCICFCICF}_2\text{CF}_2\text{-}$ , boiling point:  $60^\circ\text{C}$ ), and 1,1,1,3,3,3-hexafluoropropan-2-ol ( $\text{CF}_3\text{CH}(\text{OH})\text{CF}_3$ , boiling point:  $59^\circ\text{C}$ );

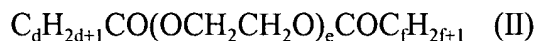
wherein the organic blowing agent further comprises at least one member selected from the group consisting of ethylene glycol compounds and amide compounds; and

wherein the ethylene glycol compound is at least one member selected from the group consisting of those of the following Formulae (I), (II) and (III):

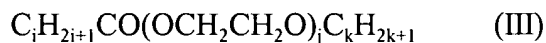


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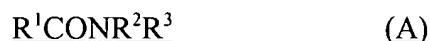
wherein a represents 1, 2, 3 or 4; b represents 1, 2 or 3; and c represents 1, 2, 3 or 4;



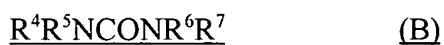
wherein d represents 0, 1, 2, 3 or 4; e represents 1, 2 or 3; and f represents 0, 1, 2, 3 or 4; and



wherein i represents 0, 1, 2, 3 or 4; j represents 1, 2 or 3; and k represents 1, 2, 3 or 4, and the amide compound is at least one member selected from the group consisting of those of the following Formulae (A) and (B):



wherein R<sup>1</sup> is a hydrogen atom, a lower alkyl group or a phenyl group; and R<sup>2</sup> and R<sup>3</sup> are the same or different, and independently represent a hydrogen atom or a lower alkyl group; with the proviso that R<sup>1</sup> and R<sup>2</sup> may form a heterocyclic ring in conjunction with the carbon atom of the carbonyl group to which R<sup>1</sup> is bound and the nitrogen atom to which R<sup>2</sup> is bound; and



wherein R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup> and R<sup>7</sup> are the same or different, and represent a hydrogen atom or a lower alkyl group, with the proviso that R<sup>4</sup> and R<sup>6</sup> may form a heterocyclic ring in conjunction with the nitrogen atom to which R<sup>6</sup> is bound, the nitrogen atom to which R<sup>4</sup> is bound and the carbon atom of the carbonyl group.

**Claims 2-4: (Canceled).**

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**Claim 5 (Previously Presented):** The process according to Claim 1, wherein the halogen-containing compound has a boiling point lower than the boiling point of HFC-365mfc (40°C).

**Claim 6 (Currently Amended):** The process according to Claim 1, wherein the halogen-containing compound is nonflammable and has a boiling point of about 10 to about 60°C and a thermal conductivity when it is in the gaseous state of about 8 to about 20 mW/mK at about 1 atmospheric pressure, and the halogen-containing compound is at least one member selected from the group consisting of perfluorohexane (C<sub>6</sub>F<sub>14</sub>), 1,1,2,2-tetrafluoroethyl difluoromethyl ether (CF<sub>2</sub>HCF<sub>2</sub>OCHF<sub>2</sub>), 1,1,2,2-tetrafluoroethyl methyl ether (CF<sub>2</sub>HCF<sub>2</sub>OCH<sub>3</sub>) and 2,2,2-trifluoroethyl-1,1,2,2-tetrafluoroethyl ether (CF<sub>3</sub>CH<sub>2</sub>OCF<sub>2</sub>CF<sub>2</sub>H).

**Claims 7-9: (Canceled).**

**Claim 10 (Previously Presented):** The process according to Claim 1, wherein the halogen-containing compound is 1,1,1,2,3,3,3-heptafluoropropane (HFC227ea: CF<sub>3</sub>CFHCF<sub>3</sub>).

**Claim 11 (Previously Presented):** The process according to Claim 1, wherein the proportion of halogen-containing compound is about 1 to about 49 mol per 100 mol of HFC-365mfc and halogen-containing compound in total.

**Claim 12 (Previously Presented):** The process according to Claim 1, wherein the catalyst is a tertiary amine, an organometallic compound, or a mixture thereof.

**Claim 13 (Currently Amended):** An organic blowing agent for producing a synthetic resin foam, the organic blowing agent comprising 1,1,1,3,3-pentafluorobutane and at least one halogen-containing compound, ~~the blowing agent being a mixture comprising 1,1,1,3,3-pentafluorobutane and at least one halogen-containing compound,~~

wherein the organic blowing agent and a polyol mixture forms a premix which is substantially nonflammable;

wherein the at least one halogen-containing compound is nonflammable and has a relatively low thermal conductivity and a boiling point of about -90 to about 60°C,

the thermal conductivity of the halogen-containing compounds in the gaseous state is about 8 to about 30 mW/mK at about 1 atmospheric pressure, and

the halogen-containing compound is at least one member selected from the group consisting of 1,2,2-trifluoroethylene trifluoromethyl ether ( $\text{CF}_2=\text{CFOCF}_3$ ), 1,2,2-trifluoroethylene 1,1,2,2,3,3,3-heptafluoropropyl ether ( $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{CF}_3$ ), perfluoropropyl epoxide ( $\text{CF}_3\text{CF}(\text{O})\text{CF}_2$ ), perfluoro-1-butene ( $\text{CF}_2=\text{CFCH}_2\text{CF}_3$ ), perfluorohexenes ( $\text{C}_6\text{F}_{12}$ ), perfluorononenes ( $\text{C}_9\text{F}_{18}$ ), perfluorohexane ( $\text{C}_6\text{F}_{14}$ ), perfluorocyclobutane ( $c\text{-C}_4\text{F}_8$ ), iodotrifluoromethyl ( $\text{CF}_3\text{I}$ ), 1,1,1,2,3,3-hexafluoropropane ( $\text{CF}_3\text{CFHCF}_2\text{H}$ ), 1,1,1,3,3,3-hexafluoropropane ( $\text{CF}_3\text{CH}_2\text{CF}_3$ ), 1,1,1,2,3,3,3-heptafluoropropane ( $\text{CF}_3\text{CFHCF}_3$ ), pentafluoroethane ( $\text{CF}_3\text{CF}_2\text{H}$ ), tetrafluoroethanes

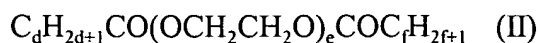
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(CHF<sub>2</sub>CHF<sub>2</sub>, CF<sub>3</sub>CFH<sub>2</sub>), trifluoromethane (CF<sub>3</sub>H), 1,1,2,2,3,3,4,4-octafluorobutane (CF<sub>2</sub>HCF<sub>2</sub>CF<sub>2</sub>CF<sub>2</sub>H), 1,1,1,2,2,3,4,5,5,5-decafluoropentane (CF<sub>3</sub>CF<sub>2</sub>CFHCFHCF<sub>3</sub>), 2-trifluoromethyl-1,1,1,2,3,4,5,5,5-nonafluoropentane (C<sub>6</sub>F<sub>12</sub>H<sub>2</sub>), 3,3,4,4,5,5,6,6,6-nonafluoro-1-hexene (F(CF<sub>2</sub>)<sub>4</sub>CH=CH<sub>2</sub>), 2,3,3,4,4,5,5-heptafluoro-1-pentene (CH<sub>2</sub>CFCF<sub>2</sub>CF<sub>2</sub>CF<sub>2</sub>H), trifluoroethylene (CF<sub>2</sub>CFH), 1,1,2,2-tetrafluoroethyl difluoromethyl ether (CF<sub>2</sub>HCF<sub>2</sub>OCHF<sub>2</sub>), 1,1,2,2-tetrafluoroethyl methyl ether (CF<sub>2</sub>HCF<sub>2</sub>OCH<sub>3</sub>), 2,2,2-trifluoroethyl 1,1,2,2-tetrafluoroethyl ether (CF<sub>3</sub>CH<sub>2</sub>OCF<sub>2</sub>CF<sub>2</sub>H), 1,1,2,3,3,3-hexafluoropropyl ~~1,1,2,3,3,3-pentafluoropropyl~~ methyl ether (CF<sub>3</sub>CFHCF<sub>2</sub>OCH<sub>3</sub>), nonafluorobutyl methyl ether (C<sub>4</sub>F<sub>9</sub>OCH<sub>3</sub>), 1-trifluoromethyl-1,2,2,2-tetrafluoroethyl methyl ether ((CF<sub>3</sub>)<sub>2</sub>CFOCH<sub>3</sub>), perfluoropropyl methyl ether (CF<sub>3</sub>CF<sub>2</sub>CF<sub>2</sub>OCH<sub>3</sub>), 2,2,3,3,3-pentafluoropropyl difluoromethyl ether (CF<sub>3</sub>CF<sub>2</sub>CH<sub>2</sub>OCHF<sub>2</sub>), 1,2,3,3,4,4-hexafluorocyclobutane (*c*-C<sub>4</sub>F<sub>6</sub>H<sub>2</sub>), 1-chloro-1,1,2,2,3,3,4,4-octafluorobutane (CF<sub>2</sub>ClCF<sub>2</sub>CF<sub>2</sub>CF<sub>2</sub>H, boiling point: 50°C), 1,2-dichlorohexafluorocyclobutane (-CFCICFCICF<sub>2</sub>CF<sub>2</sub>-, boiling point: 60°C), and 1,1,1,3,3,3-hexafluoropropan-2-ol (CF<sub>3</sub>CH(OH)CF<sub>3</sub>, boiling point: 59°C);

wherein the organic blowing agent further comprises at least one member selected from the group consisting of ethylene glycol compounds and amide compounds; and wherein the ethylene glycol compound is at least one member selected from the group consisting of those of the following Formulae (I), (II) and (III):

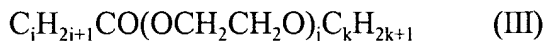


wherein a represents 1, 2, 3 or 4; b represents 1, 2 or 3; and c represents 1, 2, 3 or 4;



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wherein d represents 0, 1, 2, 3 or 4; e represents 1, 2 or 3; and f represents 0, 1, 2, 3 or 4; and



wherein i represents 0, 1, 2, 3 or 4; j represents 1, 2 or 3; and k represents 1, 2, 3 or 4, and the amide compound is at least one member selected from the group consisting of those of the following Formulae (A) and (B):



wherein  $\text{R}^1$  is a hydrogen atom, a lower alkyl group or a phenyl group; and  $\text{R}^2$  and  $\text{R}^3$  are the same or different, and independently represent a hydrogen atom or a lower alkyl group; with the proviso that  $\text{R}^1$  and  $\text{R}^2$  may form a heterocyclic ring in conjunction with the carbon atom of the carbonyl group to which  $\text{R}^1$  is bound and the nitrogen atom to which  $\text{R}^2$  is bound; and



wherein  $\text{R}^4$ ,  $\text{R}^5$ ,  $\text{R}^6$  and  $\text{R}^7$  are the same or different, and represent a hydrogen atom or a lower alkyl group, with the proviso that  $\text{R}^4$  and  $\text{R}^6$  may form a heterocyclic ring in conjunction with the nitrogen atom to which  $\text{R}^6$  is bound, the nitrogen atom to which  $\text{R}^4$  is bound and the carbon atom of the carbonyl group.

**Claims 14-15: (Canceled).**

**Claim 16 (Previously Presented):** The blowing agent according to Claim 13, wherein the halogen-containing compound is 1,1,1,2,3,3,3-heptafluoropropane (HFC227ea:  $\text{CF}_3\text{CFHCF}_3$ ).

**Claim 17 (Currently Amended):** A premix for producing a synthetic resin foam, the premix comprising an organic blowing agent ~~1,1,1,3,3-pentafluorobutane, at least one halogen-~~  
~~containing compound~~ and at least one polyol,

the blowing agent being a mixture comprising 1,1,1,3,3-pentafluorobutane and at least one halogen-containing compound,

wherein the premix is substantially nonflammable;

wherein the at least one halogen-containing compound is nonflammable and has a relatively low thermal conductivity and a boiling point of about -90 to about 60°C ,

the thermal conductivity of the halogen-containing compounds in the gaseous state is about 8 to about 30 mW/mK at about 1 atmospheric pressure, and

the halogen-containing compound is at least one member selected from the group consisting of 1,2,2-trifluoroethylene trifluoromethyl ether ( $\text{CF}_2=\text{CFOCF}_3$ ), 1,2,2-trifluoroethylene 1,1,2,2,3,3,3-heptafluoropropyl ether ( $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{CF}_3$ ), perfluoropropyl epoxide ( $\text{CF}_3\text{CF}(\text{O})\text{CF}_2$ ), perfluoro-1-butene ( $\text{CF}_2=\text{CFCH}_2\text{CF}_3$ ), perfluorohexenes ( $\text{C}_6\text{F}_{12}$ ), perfluorononenes ( $\text{C}_9\text{F}_{18}$ ), perfluorohexane ( $\text{C}_6\text{F}_{14}$ ), perfluorocyclobutane (*c*- $\text{C}_4\text{F}_8$ ), iodotrifluoromethyl ( $\text{CF}_3\text{I}$ ), 1,1,1,2,3,3,3-hexafluoropropane ( $\text{CF}_3\text{CFHCF}_2\text{H}$ ), 1,1,1,3,3,3-hexafluoropropane ( $\text{CF}_3\text{CH}_2\text{CF}_3$ ), 1,1,1,2,3,3,3-heptafluoropropane ( $\text{CF}_3\text{CFHCF}_3$ ), pentafluoroethane ( $\text{CF}_3\text{CF}_2\text{H}$ ), tetrafluoroethanes ( $\text{CHF}_2\text{CHF}_2$ ,  $\text{CF}_3\text{CFH}_2$ ), trifluoromethane ( $\text{CF}_3\text{H}$ ), 1,1,2,2,3,3,4,4-octafluorobutane ( $\text{CF}_2\text{HCF}_2\text{CF}_2\text{CF}_2\text{H}$ ), 1,1,1,2,2,3,4,5,5,5-decafluoropentane ( $\text{CF}_3\text{CF}_2\text{CFHCFHCF}_3$ ), 2-

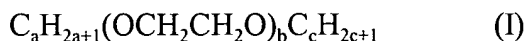


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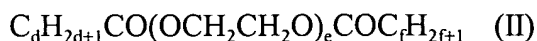
trifluoromethyl-1,1,1,2,3,4,5,5,5-nonafluoropentane ( $C_6F_{12}H_2$ ), 3,3,4,4,5,5,6,6,6-nonafluoro-1-hexene ( $F(CF_2)_4CH=CH_2$ ), 2,3,3,4,4,5,5-heptafluoro-1-pentene ( $CH_2CFCF_2CF_2CF_2H$ ), trifluoroethylene ( $CF_2CFH$ ), 1,1,2,2-tetrafluoroethyl difluoromethyl ether ( $CF_2HCF_2OCHF_2$ ), 1,1,2,2-tetrafluoroethyl methyl ether ( $CF_2HCF_2OCH_3$ ), 2,2,2-trifluoroethyl 1,1,2,2-tetrafluoroethyl ether ( $CF_3CH_2OCF_2CF_2H$ ), 1,1,2,3,3,3-hexafluoropropyl ~~1,1,2,3,3,3-pentafluoropropyl~~ methyl ether ( $CF_3CFHCF_2OCH_3$ ), nonafluorobutyl methyl ether ( $C_4F_9OCH_3$ ), 1-trifluoromethyl-1,2,2,2-tetrafluoroethyl methyl ether ( $((CF_3)_2CFOCH_3)$ ), perfluoropropyl methyl ether ( $CF_3CF_2CF_2OCH_3$ ), 2,2,3,3,3-pentafluoropropyl difluoromethyl ether ( $CF_3CF_2CH_2OCHF_2$ ), 1,2,3,3,4,4-hexafluorocyclobutane ( $c-C_4F_6H_2$ ), 1-chloro-1,1,2,2,3,3,4,4-octafluorobutane ( $CF_2ClCF_2CF_2CF_2H$ , boiling point: 50°C), 1,2-dichlorohexafluorocyclobutane ( $-CFCICFCICF_2CF_2-$ , boiling point: 60°C), and 1,1,1,3,3,3-hexafluoropropan-2-ol ( $CF_3CH(OH)CF_3$ , boiling point: 59°C);

wherein the organic blowing agent further comprises at least one member selected from the group consisting of ethylene glycol compounds and amide compounds; and

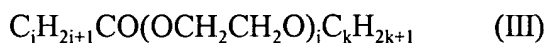
wherein the ethylene glycol compound is at least one member selected from the group consisting of those of the following Formulae (I), (II) and (III):



wherein a represents 1, 2, 3 or 4; b represents 1, 2 or 3; and c represents 1, 2, 3 or 4;



wherein d represents 0, 1, 2, 3 or 4; e represents 1, 2 or 3; and f represents 0, 1, 2, 3 or 4; and



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wherein i represents 0, 1, 2, 3 or 4; j represents 1, 2 or 3; and k represents 1, 2, 3 or 4,  
and the amide compound is at least one member selected from the group consisting of those of the  
following Formulae (A) and (B):



wherein R<sup>1</sup> is a hydrogen atom, a lower alkyl group or a phenyl group; and R<sup>2</sup> and R<sup>3</sup>  
are the same or different, and independently represent a hydrogen atom or a lower alkyl group; with  
the proviso that R<sup>1</sup> and R<sup>2</sup> may form a heterocyclic ring in conjunction with the carbon atom of the  
carbonyl group to which R<sup>1</sup> is bound and the nitrogen atom to which R<sup>2</sup> is bound; and



wherein R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup> and R<sup>7</sup> are the same or different, and represent a hydrogen atom or  
a lower alkyl group, with the proviso that R<sup>4</sup> and R<sup>6</sup> may form a heterocyclic ring in conjunction with  
the nitrogen atom to which R<sup>6</sup> is bound, the nitrogen atom to which R<sup>4</sup> is bound and the carbon atom  
of the carbonyl group.

**Claims 18-19: (Canceled).**

**Claim 20 (Previously Presented):** The premix according to Claim 17, wherein the  
halogen-containing compound is 1,1,1,2,3,3,3-heptafluoropropane (HFC227ea: CF<sub>3</sub>CFHCF<sub>3</sub>).

**Claim 21: (Canceled).**